

Appl. No. 10/720,311
Examiner: CHEN, KIN-CHAN, Art Unit 1765
In response to the Office Action dated August 29, 2005

Date: November 25, 2005
Attorney Docket No. 10113261

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (Currently Amended): A method for forming a bottle-shaped trench, comprising:
providing a semiconductor substrate with a trench having a pad stack layer thereon;
filling a mask layer into the lower portion of the trench;
using plasma nitriding a sidewall of the trench of the substrate nitridation using the mask layer as a mask to form a sidewall nitride layer on the trench sidewall;
removing the mask layer; and
etching the lower portion of the trench to form a bottle-shaped trench using the sidewall nitride layer as a mask.

Claim 2 (Original): The method as claimed in claim 1, wherein the pad stack layer comprises an oxide layer and a nitride layer.

Claim 3 (Original): The method as claimed in claim 1, wherein the mask layer is a photoresist material.

Claim 4 (Original): The method as claimed in claim 1, wherein the plasma nitridation temperature is 25~100°C.

Claim 5 (Original): The method as claimed in claim 1, wherein the lower portion of the trench is etched by wet etching.

Claim 6 (Original): The method as claimed in claim 5, wherein the wet etching solution is ammonia ($\text{NH}_4\text{OH} + \text{H}_2\text{O}$).

Claim 7 (Original): The method as claimed in claim 1, wherein the plasma nitridation pressure is 30~50Pa.

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Claim 8 (Original): The method as claimed in claim 1, wherein the plasma is RF plasma.

Claim 9 (Original): The method as claimed in claim 8, wherein the RF power is 500~1000W.

Claim 10 (Currently Amended): A method for forming a bottle-shaped trench, comprising:
providing a semiconductor substrate with a trench having a pad stack layer thereon;
filling a photoresist layer into the lower portion of the trench;
using 25~400°C plasma nitriding sidewall of the trench of the substrate nitridation to form a sidewall nitride layer on the pad stack layer and the trench sidewall, wherein the plasma nitriding step has a process temperature of about 25~100°C;
removing the photoresist layer; and
etching the lower portion of the trench to form a bottle-shaped trench.

Claim 11 (Original): The method as claimed in claim 10, wherein the lower portion of the trench etching is wet etching.

Claim 12 (Original): The method as claimed in claim 11, wherein the wet etching solution is ammonia ($\text{NH}_4\text{OH} + \text{H}_2\text{O}$).

Claim 13 (Currently Amended): The method as claimed in claim 10, wherein the plasma nitridation press pressure is 30~50Pa.

Claim 14 (Original): The method as claimed in claim 10, wherein the plasma is RF plasma.

Claim 15 (Original): The method as claimed in claim 14, wherein the RF power is 500~1000W.

Claim 16 (Original): A method for forming a bottle-shaped trench, comprising:
providing a semiconductor substrate with a trench having a pad oxide layer and a nitride layer thereon;
filling a mask layer into the lower portion of the trench;
etching a portion of the pad oxide layer near the trench to reveal a corner of the substrate;

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using plasma nitridation to form a sidewall nitride layer on the trench sidewall and to fill the pad oxide recess;

removing the mask layer; and

etching the lower portion of the trench to form a bottle-shaped trench.

Claim 17 (Original): The method as claimed in claim 16, wherein the mask layer is photoresist.

Claim 18 (Original): The method as claimed in claim 16, wherein the plasma nitridation temperature is 25~100°C.

Claim 19 (Original): The method as claimed in claim 16, wherein the lower portion of the trench is etched by wet etching.

Claim 20 (Original): The method as claimed in claim 19, wherein the wet etching solution is ammonia ($\text{NH}_4\text{OH} + \text{H}_2\text{O}$).

Claim 21 (Currently Amended): The method as claimed in claim 16, wherein the plasma nitridation ~~press~~ pressure is 30~50Pa.

Claim 22 (Original): The method as claimed in claim 16, wherein the plasma is RF plasma.

Claim 23 (Original): The method as claimed in claim 22, wherein the RF power is 500~1000W.

Claim 24 (Original): A method for forming a bottle-shaped trench, comprising:

providing a semiconductor substrate with a trench having a pad oxide layer and a nitride layer thereon;

filling a photoresist layer into the lower portion of the trench;

etching a portion of the pad oxide layer near the trench to reveal a corner of the substrate;

using the 25~100°C plasma nitridation to form a sidewall nitride layer on the trench sidewall and to fill the pad oxide recess;

removing the photoresist layer; and

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etching the lower portion of the trench to form a bottle-shaped trench.

Claim 25 (Original): The method as claimed in claim 24, wherein the lower portion of the trench is etched by wet etching.

Claim 26 (Original): The method as claimed in claim 25, wherein the wet etching solution is ammonia ($\text{NH}_4\text{OH} + \text{H}_2\text{O}$).

Claim 27 (Original): The method as claimed in claim 24, wherein the plasma nitridation pressure is 30~50Pa.

Claim 28 (Original): The method as claimed in claim 24, wherein the plasma is RF plasma.

Claim 29 (Original): The method as claimed in claim 28, wherein the RF power is 500~1000W.